Commonwealth Biomonitoring, Inc.

8061 Windham Lake Drive
Indianapolis IN 46214
(317) 297 - 7713

water_quality@tcon.net
www.biomonitor.com

Tippecanoe Lake Storm Drain Project

An Engineering Feasibility Study
Prepared for:

Tippecanoe Environmental Lake
and Watershed Foundation

and

Indiana Department of Natural Resources
Division of Fish and Wildlife
Lake and River Enhancement Program

Final Draft
March 2006

TABLE OF CONTENTS

Tables

Figures

Appendices

EXECUTIVE SUMMARY

Runoff from storm water frequently contains pollutants such as phosphorus, nitrogen, oil, and sediment that can cause impairment to lakes and streams. Reducing inputs from storm water runoff is an important management goal for lake associations as they seek to improve water quality. This project was designed to map the location of existing storm drains around Tippecanoe Lake in Kosciusko County, Indiana and recommend solutions for addressing pollutants entering the lake in storm water runoff from streets surrounding the lake.

Storm drains were located by driving around each subdivision on the lake, looking for inlets on streets. After the inlets were located and mapped, fluorescent dye was placed in each inlet and water samples were collected at pipes draining into the lake. The dye was detected by a hand-held field fluorometer. Once located, the storm drain inlets and outlets were mapped on a geographic information system (GIS) database. Forty street drains and thirty-nine inlet pipes were identified in the study.

After the mapping was completed, the project included an analysis of potential effects of pollutants from storm drains. Computer modeling showed that runoff from approximately 10 hectares (25 acres) of impervious road and parking lot surfaces near Tippecanoe Lake account for approximately 11 kg (25 pounds) of phosphorus, 54 kg (125 pounds) of nitrogen, and 10000 kg (10 tons) of sediment each year. Eliminating this amount of loading will reduce total nutrient concentrations in the lake by about 2%.

In addition to mapping and modeling, the project also included a plan to reduce pollutant loading from storm drains. Plans developed as part of this project include installation of catch basin inserts, construction of vegetative swales, construction of wetlands, and construction of bioretention filters or “rain gardens.” Several local property owners expressed interest in pursuing construction options and preliminary drawings for these potential projects were prepared. Costs to implement the plan range from $1000 for individual household rain gardens, $4000 annually for catch basin inserts, and about $40,000 for construction of two infiltration trenches.

Three public meetings were held during the duration of this project. The first meeting in May 2004 explained what the project was trying to accomplish. A second meeting was held in August 2004 after the storm drain mapping was complete to report on where storm drains are located. The final meeting was held at the end of the project in January 2005, to report all results and provide a forum for what needs to be done next. A brochure summarizing the project was distributed at the final meeting.

INTRODUCTION

Tippecanoe Lake in Kosciusko County, Indiana is one of Indiana's largest glacial lakes. In 1994, local residents sponsored a Lake and River Enhancement (LARE) "diagnostic study" to identify potential water quality problems in the lake and to propose specific directions for fixing the problems [1]. The diagnostic study documented a trend of increasing eutrophication of the lake. The mean total phosphorous concentration in Tippecanoe Lake had risen from 20 μg/L in 1973 to 70 μg/L in 1994. This increase in phosphorus could lead to increases in nuisance plant and algal growth, to decreased water clarity, and to potential degradation of uses of the lake for swimming, boating, and fishing.

In response, residents began to seek solutions to the phosphorus problem. Several watershed "best management practices" were identified and implemented. Although not specifically addressed in the Tippecanoe Lake Diagnostic Study, storm water runoff can be a significant input of nutrient and debris loading to the lake [2]. In residential areas with asphalt roads, runoff is frequently diverted without treatment by storm drains discharging to nearby waterbodies. The number and location of storm drains around Tippecanoe Lake was not identified in the diagnostic study and there is no map in existence for these drains within the city or county government offices.

To address this problem, the Tippecanoe Environmental Lakes and Watershed Foundation (TELWF) applied for and received an "Engineering Feasibility Study" grant from the Indiana Department of Natural Resources in 2003. The purpose of the grant, administered by the Lake and River Enhancement (LARE) program, was to identify storm drains flowing into Tippecanoe Lake and prepare a plan for reducing their detrimental effects on water quality of the lake,

Fig.1. Location of Tippecanoe Lake within Indiana

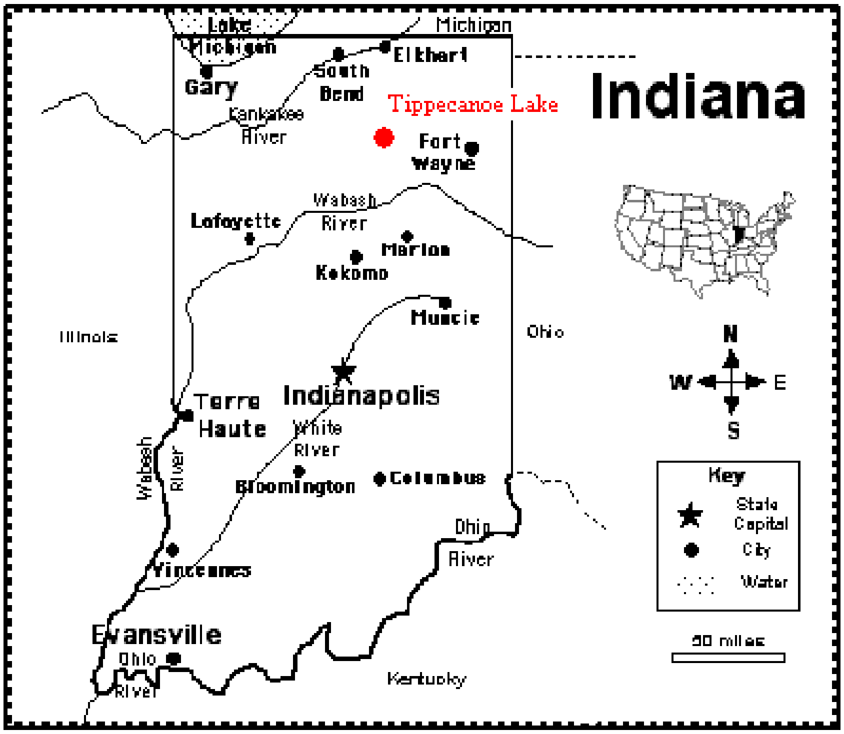


Fig. 2. Tippecanoe Lake and Surrounding Area

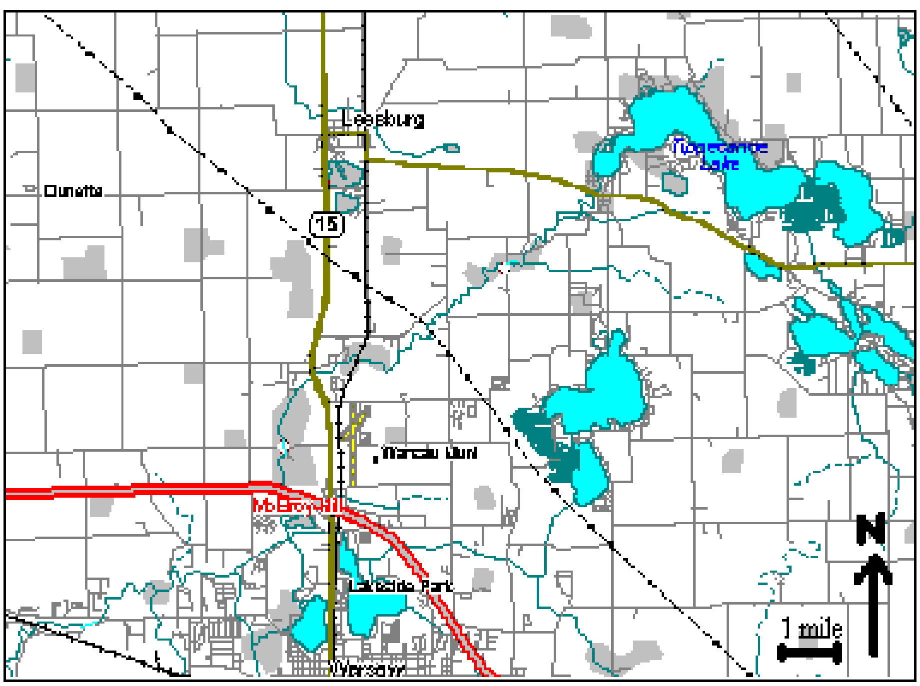
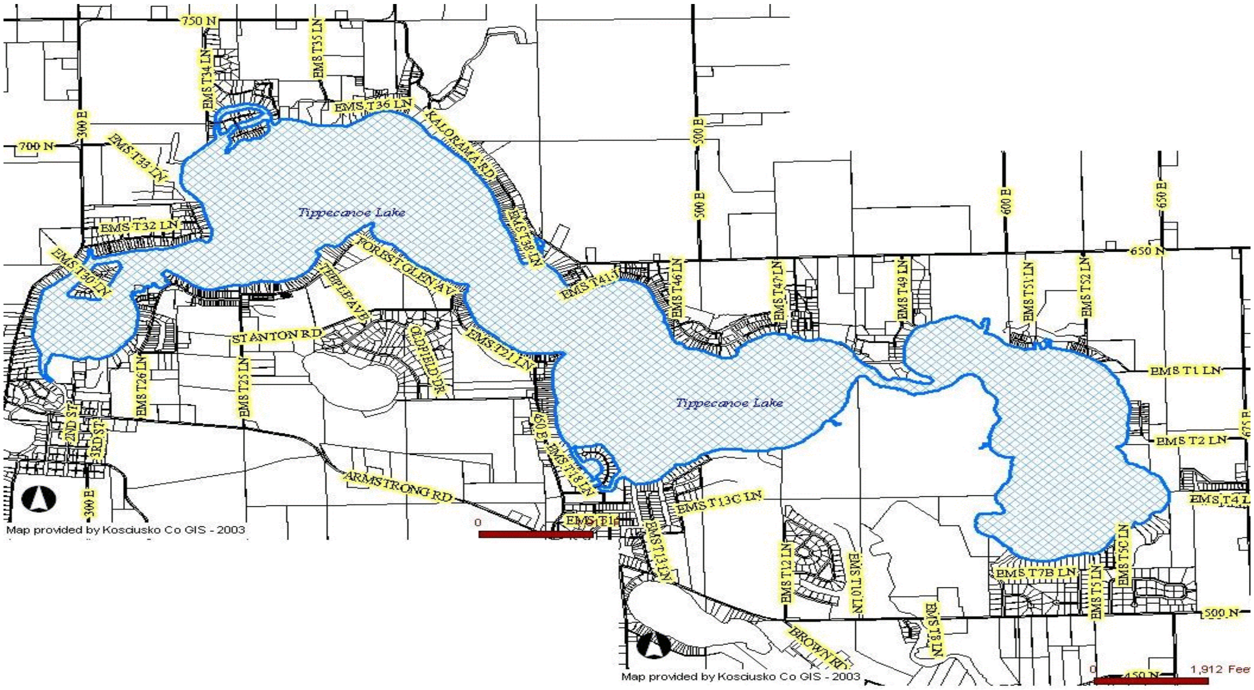


Fig. 3 Tippecanoe Lake and surrounding roads and streets



Although many of the streets of the north side of the lake are unpaved gravel, there are a total of about 25 kilometers (15 miles) of paved streets surrounding the lake. This represents an impervious area (an area in which rain water can't sink into the ground) of approximately 10 hectares (25 acres). Storm water runoff from the hard paved surfaces generally runs directly into Tippecanoe Lake with no treatment. There are presently no maintenance programs in place to clean out existing storm drain catch basins.

Previous studies of storm water runoff throughout the United States have shown that urban street runoff contains high amounts of nitrogen, phosphorus, and oil [4]. The goal of this project is to locate the places where street storm water runoff enters Tippecanoe Lake and devise a plan for reducing pollution inputs from these sources. The LARE guidelines for "engineering feasibility studies" were used as the basis for preparation of the report.

PROJECT TASKS

There are 16 tasks in a typical LARE engineering feasibility study:

- Identify potential construction sites
- Complete preliminary engineering calculations
- Facilitate 3 public meetings on the project
- Create a public information handout
- Issue monthly progress reports
- Complete conceptual drawings
- Determine project cost estimates and timelines
- Determine easements and land availability
- Determine unusual costs of the proposed project
- Determine impacts of the project on the lake
- Determine funding sources for design & construction projects
- Conduct an impact assessment of the project on lake biology, water quality, and flooding
- Justify proposed site selection
- Complete early coordination process for obtaining all necessary project permits
- Update any critical information gaps
- Complete a written engineering feasibility report

These tasks were all carried out during the 2004 grant period. Project methods and results are reported below.

METHODS

At the beginning of the project in April 2004, a field crew drove around the entire lake, mapping the location of street grates with a Geographic Positioning System (GPS) receiver. The streets around Stanton Lake were also examined, since runoff from Stanton Lake flows into Tippecanoe Lake. During two field surveys in the spring and summer of 2004, crews also boated around the perimeter of the lake mapping the location of potential storm water pipes with a GPS receiver. Local lake residents also reported the presence of additional grates and pipes not spotted by the field crew.

After the inlets and pipes locations were identified, a 10 gram tablet of fluorescent dye (Brightdyes, Kingscote Chemicals) was placed in each inlet during wet weather in the summer of 2004. The amount of dye was too low to be seen by the naked eye but was easily detected by a hand-held Turner Designs fluorometer. By taking samples of water flowing from the pipes into the lake, the location of the pipe's correlated street drain was determined.

RESULTS

There were 39 storm water inlet pipes like the ones shown in Fig. 4 identified in the study. Locations of the inlet pipes are shown in Fig. 5.

Fig. 4. Examples of storm water inlet pipes

Fig. 5. Location of storm water inlet pipes

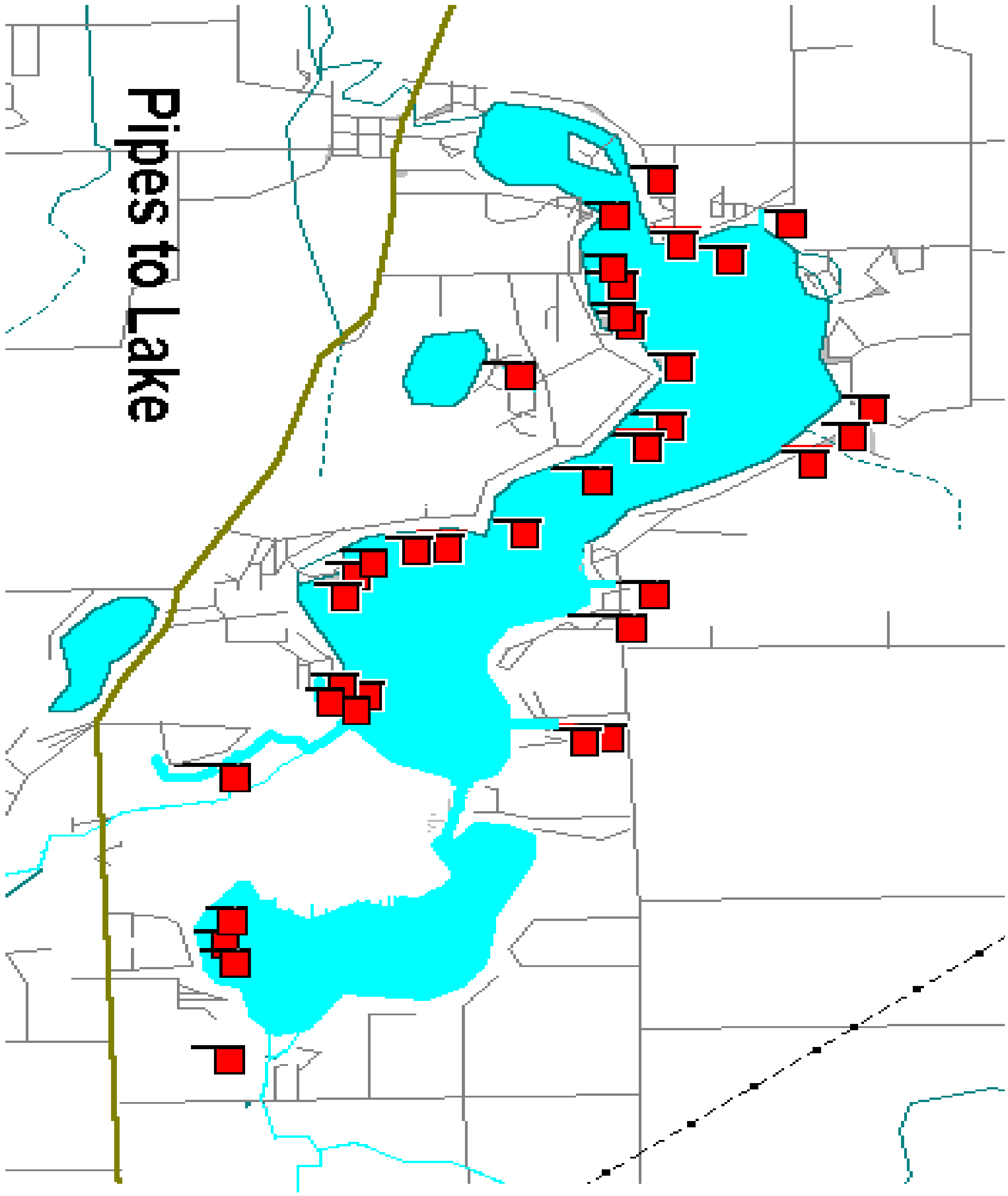


Table 1. Location of storm water pipes flowing into the lake. Also see map in Fig. 5

Pipe Number	Latitude	Longitude	Associated inlets
1	41.1982	85.4712	2
2	41.1980	85.4691	3
3	41.1980	85.4690	4-6
4	41.1990	85.4674	4-6
5	41.2013	85.4688	Patona Bay runoff
6	41.2028	85.4603	9
7	41.2025	85.4595	Tributary runoff
8	41.2015	85.4584	11
9	41.1976	85.4410	Kalorama Road runoff
10	41.1958	85.4508	12-13
11	41.1964	85.4461	14
12	41.1960	85.4461	15
13	41.1866	85.4326	32-36
14	41.1872	85.4354	16
15	41.1870	85.4369	Lakeside Subdivision runoff
16	41.1870	85.4375	Lakeside Subdivision runoff
17	41.1868	85.4443	17-18
18	41.1905	85,4473	Private drains
19	41.1895	85.4480	21
20	41.1894	85.4483	20
21	41.1894	85.4484	19
22	41.1894	85.4524	Marina runoff
23	41.1901	85.4534	22
24	41.1909	85.4540	23
25	41.1918	85.4544	24
26	41.1918	85.4544	24
27	41.1945	85.4551	Government Point - No flow
28	41.1953	85.4574	Forest Glen runoff
29	41.1975	85.4594	Forest Glen runoff
30	41.1980	85.4601	Forest Glen runoff
31	41.1984	85.4629	Forest Glen runoff
32	41.1979	85.4633	Forest Glen runoff
33	41.1971	85.4638	Stanton Lake overflow
34	41.1970	85.4643	25
35	41.1970	85.4644	26
36	41.1969	85.4645	27
37	41.1968	85.4666	Tippy Ballroom roof drain
38	41.1967	85.4667	29
39	41.1968	85.4692	28

About 65% of all storm water pipes were attached to a street drain inlet. One pipe no longer carries storm water flow. Instead of street runoff, several pipes carry roof drain water or other types of storm-related runoff. Pipe number 33 carries the overflow from Stanton Lake, which includes street runoff.

During the survey, 40 street drains like the one shown in Fig. 6 were identified and mapped. Generalized locations of all street drains are shown in Fig. 7 and identified by latitude and longitude in Table 2. They are also shown in maps in Appendix D.

Fig. 6. A typical street drain with an inlet to Tippecanoe Lake

Fig. 7. Generalized location of street drains

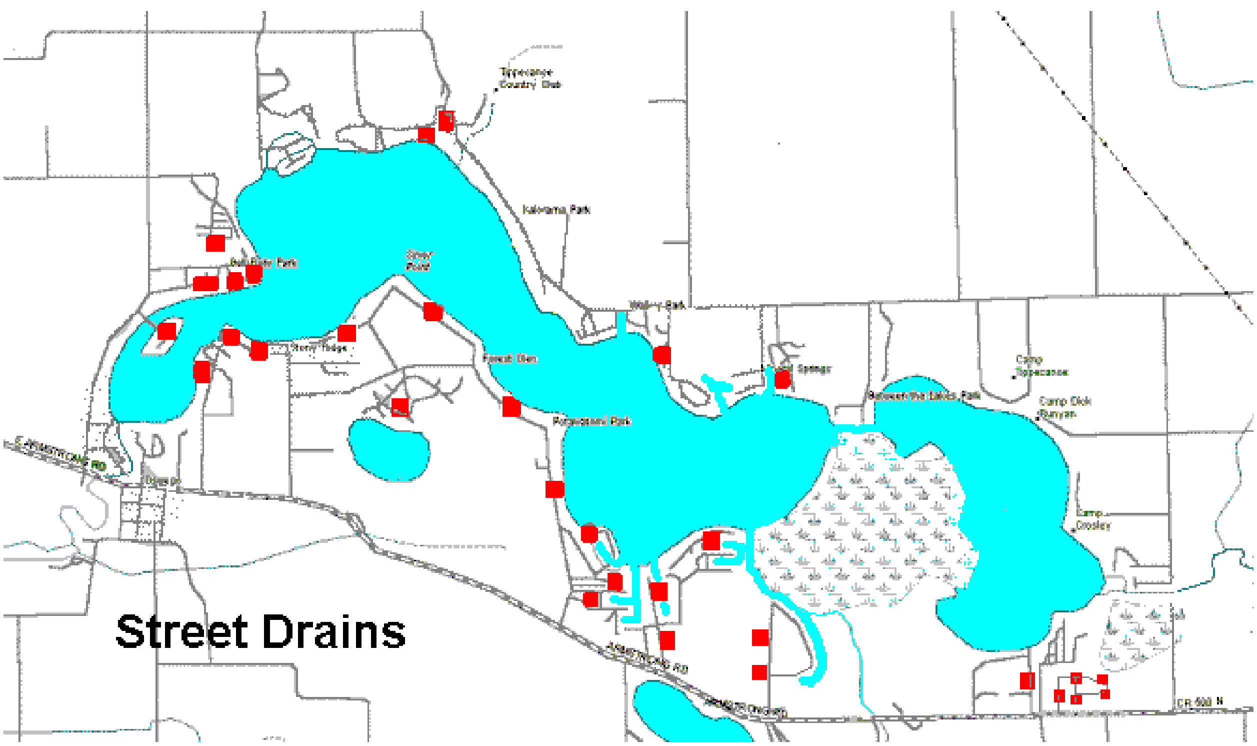


Table 2. Location of street drain inlets. Also see map in Fig. 7

Inlet Number	Latitude	Longitude	Street	County Maintenance?	Associated Pipe
1	41.1970	85.4712	T30A	yes	none
2	41.1982	85.4717	T31	yes	1
3	41.1985	85.4681	T31	yes	2
4	41.1985	85.4683	T31	yes	3
5	41.1989	85.4680	T32C	yes	4
6	41.1988	85.4680	T32C	yes	4
7	41.1988	85.4779	T32C	yes	4
8	41.2000	85.4692	T33M	no	none
9	41.2034	85.4604	T36	yes	6
10	41.2036	85.4598	Country Club	no	none
11	41.2034	85.4592	Kalorama	yes	7
12	41.1960	85.4503	T45	yes	10
13	41.1958	85.4503	T45	yes	10
14	41.1951	85.4454	T48	yes	11
15	41.1951	85.4454	T48	yes	12
16	41.1855	85.4353	T6	yes	14
17	41.1860	85.4460	T12	no	17
18	41.1872	85.4460	T12	no	17
19	41.1902	85.4486	T13F	yes	19
20	41.1903	85.4481	T13F	yes	20
21	41.1904	85.4480	T13F	yes	21
22	41.1890	85.4533	T16	yes	23
23	41.1890	85.4537	T16	yes	24
24	41.1906	85.4536	T18	yes	25-26
25	41.1964	85.4643	Forest Glen	yes	34
26	41.1964	85.4644	Forest Glen	yes	35
27	41.1964	85.4645	Forest Glen	yes	36
28	41.1949	85.4692	Forest Glen	yes	39
29	41.1962	85.4667	T26	yes	38
30	41.1962	85.4682	T26	yes	38
31	41.1965	85.4683	T26	yes	38
32	41.1859	85.4325	Sawgrass	no	13
33	41.1862	85.4325	Sawgrass	no	13
34	41.1856	85.4330	Village Dr.	no	13
35	41.1862	85.4330	Sawgrass	no	13
36	41.1856	85.4335	Sawgrass	no	13
37	41.1940	85.4591	Lakeview	yes	(Stanton Lake)
38	41.1943	85.4616	Oldfield Dr.	yes	(Stanton Lake)
39	41.1949	85.4695	Oldfield Dr.	yes	(Stanton Lake)
40	41.1954	85.4601	Oldfield Dr.	yes	(Stanton Lake)

About 90% of all street drains flowed directly into Tippecanoe Lake through an attached outlet pipe. A few drains were not attached to a pipe but instead flowed to a vegetated area before discharging to a lake. The Kosciusko County Highway Department has maintenance responsibilities for 75% of the street drain inlets. The remainder are private or are the responsibility of a local property owner's assocation.

DISCUSSION

I. Potential "best management practices" to control runoff quality

Figure 5 shows that the storm drain inlets on Tippecanoe Lake are widely scattered over an area of almost 20 square kilometers (8 square miles). Therefore, a centralized treatment system to treat all storm water in the watershed would be impractical. Instead, the best solution for improving runoff quality to the lake is to use small, localized treatment systems. During the past 20 years there has been an increasing emphasis on finding ways to improve water quality in storm water runoff. Many "best management practices" (BMPs) have been proposed and tested for both urban and agricultural runoff [3]. Some of those found to be most effective for storm water runoff from streets and parking lots associated with urban and residential storm drains include:

Storm water retention ponds
Artificial wetlands
Open channel systems (biofilters, dry and wet swales, grass channels)
Filtering systems (vegetative filter strips, sand filters, compost filters)
Infiltration systems (porous pavement, underground trenches)
Catch basin inserts
Street sweeping

An example of an existing storm water treatment system installed by the developer of Lakeside Subdivision on Little Tippecanoe Lake is shown in Fig. 8. This system is a "vegetated swale" that slows down the drainage process and uses vegetation to trap sediment particles and enhance infiltration before the storm water reaches the lake. This type of system is very inexpensive (less than $30 per linear foot to install) and easily maintained (regular mowing and removal of cuttings),

Fig. 8. A vegetated swale.

Note the three storm water pipes on the upstream end of the swale. Much of the water flowing from these pipes sinks into the ground before discharge to the lake. This has the benefit of cleaning up the storm water and re-charging the ground water.

Another example of an existing storm water treatment system in the Sawgrass Subdivision on Little Tippecanoe Lake is shown in Fig. 9 This BMP is similar to a "vegetated swale" but uses wetland plants to treat the water prior to discharge to the lake. It is even more effective at pollutant removal than a vegetated swale because the storm water more completely infiltrates the soil and is incorporated into the tissues of vegetation before it reaches the lake.

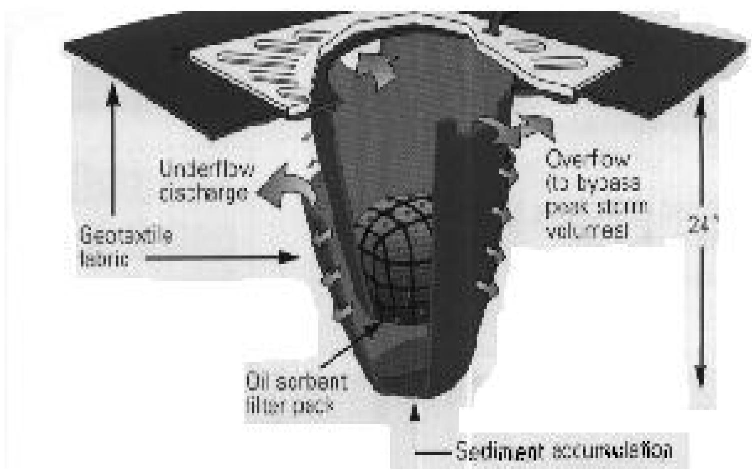
Fig. 9. Wetland storm water treatment Sawgrass Subdivision

A potential site for development of a storm water treatment wetland is at the outlet of Stanton Lake along Forest Glen Avenue on the south side of the lake. This site receives storm water runoff from streets around Stanton Lake. A photo of the site is shown in Fig. 10. This site is owned by Patona Enterprises, which has expressed interest in exploring the possibility of a wetland treatment system.

Fig. 10. Overflow from Stanton Lake Potential wetland treatment site.

Catch basin inserts can be a very cost-effective way to reduce pollutants from street runoff. Some of them are designed to trap both sediment and oil associated with street runoff. An example of an insert made of heavy-duty geofabric material is shown in Fig. 11. These inserts could be used in each one of the 35 street drain inlets listed in Table 2.   The cost of a catch basin insert is less than $100 and the insert can be used for up to a year before replacement. Therefore, the total cost of a catch basin insert program to cover the entire lake would be less than $3500 per year if volunteers were used to maintain them. A trial period at a few of the catch basins might be a good way to evaluate the effectiveness of a larger lake-wide program.

Fig. 11. A typical catch basin insert



To install the inserts, volunteers simply pry up the iron grate covering the basin with a crowbar, place an insert into the hole, replace the grate, and trim off the excess fabric with a knife or scissors. For maintenance, volunteers pry up the grate, empty the contents into a waste barrel, replace the insert back into the hole (the same insert has been used up to 10 times a year), and replace the grate.

The trapped sediment in the waste barrel may be composted at an upland site away from the lake. There is a possibility that the filters may also trap oil and heavy metals that could be hazardous in high concentrations. Therefore, it is important to compost the contents with other organic material to prevent chemical “build-up.” The oil absorbant filter pack should be collected separately and sent to a sanitary landfill or other appropriate disposal site.

The catch basin insert recommended for use at Tippecanoe Lake is the “Stream Guard” sold by PCI. It has been tested in Indiana and found to have high pollutant removal efficiency and ease of use [8].   The insert can be purchased from:

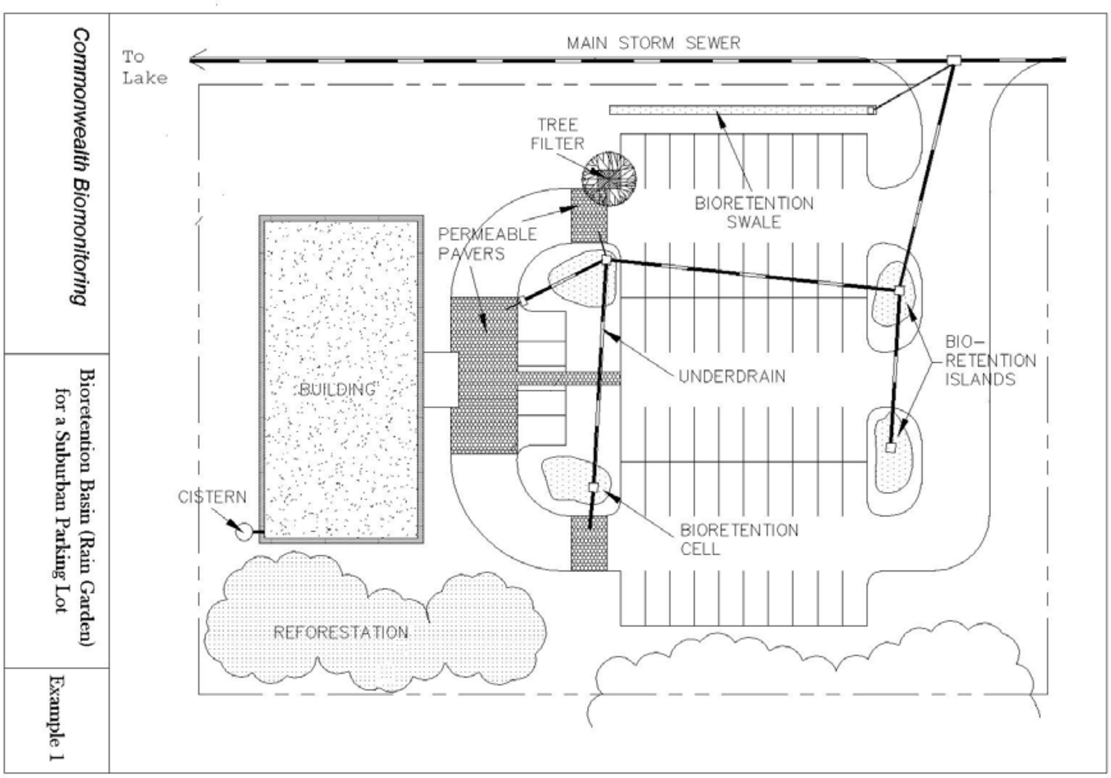
PCI: Absorbants Online.com
4195 Chino Hills Parkway #360
Chino Hills CA 91709
1-800-869-9633

Bowhead Manufacturing Co., LLC
P.O. Box 80327
Seattle WA 98108
1-800-909-3677

Another type of Best Management Practice for street runoff is the installation of bioretention filters, also known as “rain gardens,” at strategic locations where rain water collects [7]. An example of a what a typical rain garden looks like is shown in Fig. 12. A site plan showing how rain gardens may be incorporated into a property is shown in Fig. 13.

Fig. 12. A typical rain garden

Fig. 13. Site plan showing how rain gardens (also known as bioretention filters or cells) may be incorporated into a property.



Rain gardens could be installed at many sites around the lake to filter pollutants from storm water runoff. Their cost is low (less than $10 per square foot for plants and installation labor). The soils around Tippecanoe Lake consist primarily of sands or sandy loams (Kosciusko, Ormas, and Riddles soils). Plants suitable for rain gardens in this type of soil in full or partial sun are shown in Table 3.

Table 3. Plants suitable for rain gardens around Tippecanoe Lake

Latin Name	Common name	Bloom time	Height	
Allium cernuum	*nodding pink onion*	*summer*	*1-2'*	
Asclepias incarnata	*marsh milkweed*	*early summer*	*3-5'*	
Aster novae-angliae	*New England astor*	*fall*	*3-6'*	*
Baptisia leucantha	*white false indigo*	*early summer*	*3-5'*	
Carex vulpinoidea	*fox sedge*	*non-blooming*	*1-3'*	*
Eupatorium maculatum	*spotted joe-pye weed*	*fall*	*4-6'*	*
Helenium autumnale	*sneezeweed*	*fall*	*3-5'*	
Iris versicolor	*blue flag iris*	*early summer*	*2-3'*	
Juncus torreyi	*torrey's rush*	*early summer*	*1-2'*	
Liatris spicata	*dense blazingstar*	*summer*	*3-5'*	
Lobelia siphilitica	*great blue lobelia*	*late summer*	*1-3'*	*
Monarda fistulosa	*wild bergamot*	*summer*	*2-4'*	
Panicum virgatum	*switch grass*	*summer*	*3-5'*	
Parthenium integrifolium	*wild quinine*	*summer*	*3-5'*	
Pycnanthemum virg.	*mountain mint*	*summer*	*1-2'*	
Rudbeckia subtomentosa	*sweet black-eyed susan*	*late summer*	*4-6'*	
Solidago ohioensis	*ohio goldenrod*	*fall*	*3-4'*	*
Veronia fasciculata	*ironweed*	*late summer*	*4-6'*	

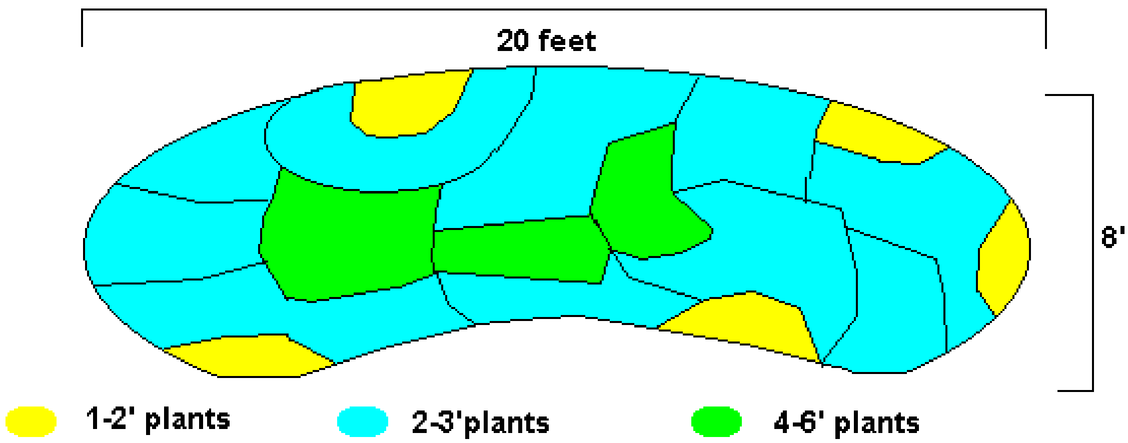
For shadier areas, the following plants should be substituted for their equivalent sun-tolerant species marked with an * above:

Aster lateriflora	*side-flowering aster*	*fall*	*1-3'*
Carex grayii	*burr sedge*	*non-blooming*	*1-3'*
Eupatorium rugosum	*white snakeroot*	*fall*	*2-4'*
Lobelia cardinalis	*cardinal flower*	*late summer*	*1-3'*
Solidago flexicaulis	*zig zag goldenrod*	*fall*	*1-2'*

These facultative wetland plants are readily available at local nurseries and usually cost about $1-2 per plant. Each plant requires about 1 square foot at planting time.

An example of a rain-garden plan or design that is adaptable for most lake-area sites is shown in Figure 13.

Fig. 14. A typical rain garden plan for 160 square feet



Rain gardens would be practical in many individual residential yards where there is no communal property but where storm water runoff from streets or other sources collects regularly. These would be funded and maintained by individual landowners.

In addition, rain gardens would be appropriate in community-owned areas where the lake association could assist with funding and maintenance for cleanup of street runoff. Examples of sites where rain gardens would be appropriate for this use are in Bell Rohr Park and Russell Park. Another site where a rain garden would be useful is adjacent to the parking lot of the Tippy Ballroom (Fig. 14). A community rain garden that is 200 square feet in area should cost less than $2000 to build and less than $500 a year to maintain.

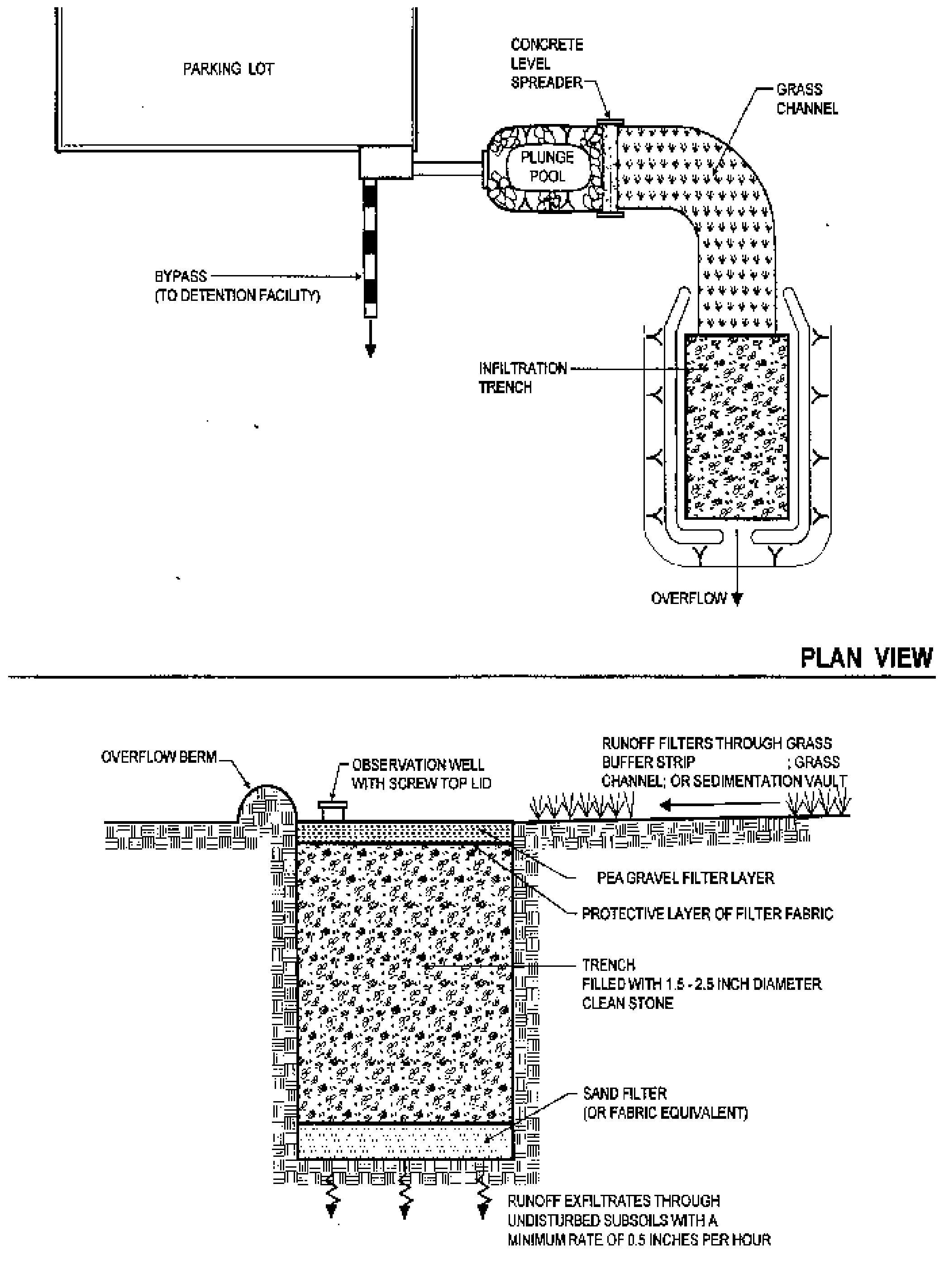
Fig. 15. Tippy Ballroom parking lot
Potential rain garden site

Another BMP that could be implemented for water quality improvement is a sediment basin to collect and treat runoff along Kalorama Road, where street runoff now flows directly into a gully and then to the lake. A sediment basin similar to the one shown in Fig. 15 would be help improve water quality at this site, owned by Paton Enterprises.

Fig. 15. Sediment basin to trap storm runoff

Finally, many agencies charged with cleaning up storm water runoff are finding that “infiltration trenches” are effective where land is at a premium. This technology makes use of a sand/compost filter material that traps pollutants using both physical and chemical binding before they are discharged. A drawing of a typical infiltration trench is shown in Fig. 16. An excellent location for an infiltration trench is along Kalorama Road near Walker Park, where street runoff presently discharges directly to a channel connected to the lake. The property at this site is owned by Paton Enterprises, which has expressed interest in participating. Another good location is along Forest Glen Avenue on the south side of the lake. This property is owned by the county and is bordered by Indian Hills Golf Course.

Fig. 16. An example of a filtration trench



Infiltration Trench

Figure 17 shows the locations of six possible storm water BMP sites in the Tippecanoe Lake area.

Fig. 17. Potential BMP Sites

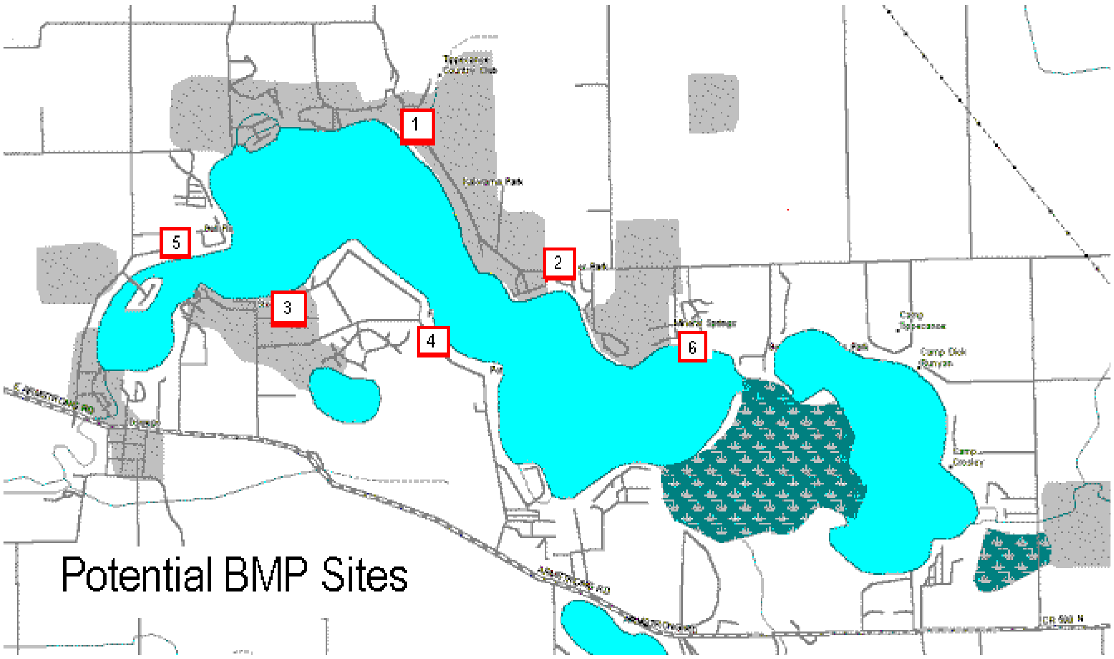


Table 4. Potential costs of BMP implementation

BMP	Unit Cost	Removal Efficiency for TSS [3]	Site in Fig 17
Rain garden	$10 per square foot	65%	5, 6
Catch basin insert	$85 per basin	75-90%	N/A
Sediment basin	$3500	70%	1
Infiltration trench	$20,000 per filter	95%	2.4
Wetland enhancement	$10 per square foot	80%	3

Cost estimates are based on recent projects cited in [9].

II. Unusual Costs

Because of the high cost of land near the lake, BMPs that require more than a few hundred yards of space will have unusually high costs. The typical cost of lake-side property at Tippecanoe Lake in 2004 was over $100,000 per acre. Therefore, recommendations for BMPs in the Tippecanoe Lake area will emphasize those with few space requirements. Street sweeping requires the purchase of expensive machinery and is not recommended for this project.

III. Funding sources

Implementing many parts of this plan require no outside funding sources. For example, because of their low cost and aesthetic value, small rain gardens can be easily financed by individual land owners. A batch of catch basin inserts could be purchased in bulk from association funds and maintained by association volunteers.

For more expensive projects, there are several potential funding sources that could help the lake association implement the plan. For projects less than $5000, the Indiana Lakes Management Society has a "small grants program" that will fund BMPs that treat storm water runoff. The program runs through 2006 and grant applications are available on the ILMS website (www.ilms.org).

The LARE program of the Indiana Department of Natural Resources will also fund some storm water BMPs. LARE's primary focus is runoff associated with agriculture, so treating runoff from streets will not receive high priority in grant requests to this program.

The Indiana Department of Environmental Management's Section 319 program will also fund storm water BMPs. The BMPs must be approved by a Soil and Water Conservation District professional, so coordination with the Kosciusko County SWCD office is vital for this grant application.

IV. Prioritization of Sites

As the LTPOA and other neighborhood groups around Tippecanoe Lake begin to implement this plan, it will be beneficial to establish a set of priorities. Those projects that bring the most benefits at the lowest cost with the fewest hurdles should be tackled first. Therefore, the following list of priorities is recommended:

1. The LTPOA should decide how to fund an implement a catch basin insert program for the 35 street storm drains around the lake. This program could provide immediate benefits at low cost with no permits or land acquisition required. All street storm drains could benefit by this program, although those flowing into vegetated swales and wetlands around Little Tippecanoe Lake and around Stanton Lake may have lower priority because some treatment is already being provided.

2. Encourage local residents to incorporate rain gardens into their landscapes. This program is also low-cost and requires no permits or additional land. It will also add additional aesthetic value to the neighborhoods.

3. Two local neighborhood associations (Bell Rohr Park and Russell Park) should consider the planting of community rain gardens to treat storm water runoff from streets in their neighborhoods. The land is already owned by the associations, so no additional land acquisition is needed. The associations would need to determine how to pay for them (about $2000 each) and maintain them ($500 annually). Applying for a small grant from ILMS during 2005 is recommended.

4. Higher cost treatments may require additional outside funding. The LTPOA or TELWF may want to consider seeking grants to pursue these options.

V. Potential Project Timeline

Applying for funding grants can be done any time but each program has application deadlines. The ILMS small grants program accepts applications four times a year through 2006. The LARE program accepts applications before January 31 each year. The Section 319 applications are due in before October 31 each year. A recommended project timeline is shown in Table 5.

Table 5. Possible Project Timeline

When	***What***	***Who***
March 2005	Newsletter article about rain gardens	LTPOA
April 2005	Seek volunteers to maintain catch basin inserts	LTPOA
May 2005	Purchase catch basin inserts Start using them	LTPOA
July 2005	Apply for ILMS grant for rain gardens	Belle Rohr Assoc. Russell Park Assoc.
Jan. 2006	Apply for LARE grant for infiltration trench, wetland, sediment basin design	LTPOA or TELWF
May 2006	Install rain gardens	Private householders Belle Rohr Assoc. Russel Park Assoc.
Oct. 2006	Apply for 319 grant for infiltration trench, wetland, sediment basin construction	LTPOA or TELWF
Mar. 2007	Select contractors for BMPs	LTPOA or TELWF
Aug. 2007	Complete construction on BMPs	Selected contractors

VI. Predicting the potential beneficial effects on Tippecanoe Lake by implementing storm water "best management practices"

One of the tasks of a LARE Engineering Feasibility Study is to determine the potential impacts of the project on the lake. There is a computer model called Eutromod, developed by the Duke University and the North American Lake Management Society [5], that uses land use data to predict nutrient loading and water quality in lakes. For example, the model uses data from previous studies [6] that show street runoff contains significant amounts of phosphorus and nitrogen. Therefore, the model can be used to predict how eliminating this loading source will affect water quality. A summary of the model output for Tippecanoe Lake is shown in the appendix.

There are approximately 25 km (15 miles) of paved roads and streets that drain directly into Tippecanoe Lake. This represents an impervious surface area of 10 hectares (25 acres) that carry storm water directly into the lake without treatment. Eutromod predicts that eliminating runoff nutrients from 10 hectares of road surface would reduce lake loading by 11 kg (25 pounds) of phosphorus and 54 kg (125 pounds) of nitrogen annually.

The amount of nutrient loading from street runoff immediately adjacent to Tippecanoe Lake is relatively small compared to total lake loading (e.g. 0.04% for phosphorus) and the model predicts that completely eliminating runoff from adjacent streets will have no measurable effect on lake water quality. Nevertheless, since the amount of impervious surface area is only 0.006% of the total watershed area, its net effect is much larger than its size (a sign that it is economically important to treat!).

RECOMMENDATIONS

Because controlling storm water quality around Tippecanoe Lake is one of the most cost-effective ways of reducing nutrient inputs that affect lake water quality, implementing a Best Management Practices plan around the lake is highly recommended. The recommended BMPs for this lake are:

Catch basin inserts (40)
Bioretention filters (at least 3)
Infiltration trench (2)
Sediment basin (1)
Wetland enhancement (1)

LITERATURE CITED

1. J.F.New & Associates, 1995. Diagnostic study of Tippecanoe Lake. Prepared for the Lake Tippecanoe Property Owner's Association. Indiana Department of Natural Resources, Division of Soil Conservation, Indianapolis, IN.

2. U.S. EPA, 1983. Results of the Nationwide Urban Runoff Program. Vol I - Final Report. Water Planning Division, Washington, D.C. WH-554.

3. Brown, W. and T. Schueler, 1997. National pollutant removal performance database for stormwater BMPs. Center for Watershed Protection, Silver Spring, MD.

4. Bannerman, R. et al. 1984. Evaluation of urban nonpoint source pollution management in Milwaukee County, Wisconsin. U.S. EPA, Region V, Chicago, IL.

5. Reckhow, K.H. et al. 1992. Eutromod: technical guidance and spreadsheet models for nutrient loading and lake eutrophication. Duke University School of the Environment, Durham, NC.

6. Thomson, N.R. et al. 1997. Highway stormwater runoff quality: development of surrogate parameter relationships. Water, Air, Soil Pollut. 94:307.

7. Low-Impact Development Center, 2004. The bioretention manual. Prince Georges County, Envir. Res. and Planning Div., Beltsville, MD.

8. Commonwealth Biomonitoring, 2002. The Yellow River water quality improvement project. ARN 00-39. Ind. Dept. Envir. Mgmt, Water Management, Indianapolis, IN.

9. U.S. Navy, 2004. Storm water best management practices decision support tool. http://enviro.nfesc.navy.mil/stormwaterbmp/html/ida_bmpl.htm.

Appendix A. Eutromod Predictions

Term	Units	Estimate
Lake Area	Km^2	3.12
Mean Depth	meters	12
Detention Time	years	0.59
Areal Water Loading	m/yr	20.5
Volumetric WaterLoad	10^6m^3/yr	64
Lake Volume	10^6m^3	37.44
Stream Runoff*	m/yr	0.8
Watershed Area	Km^2	80
Lake Evaporation	meters	1.39
Watershed/Lake Area	Ratio	25.6

Total Land Areas, Septic Tank Inputs

Land Use Category	Area (hectares)	Septic Tanks	
Agriculture1	0	#Capita-yrs	3000
Agriculture2	130000	P/pers-yr	1.25
Agriculture3	0	N/pers-yr	4.75
Agriculture4	0	P-soil ret	0.69
Agriculture5	0	N-soil ret	0.3
Forest	30000		
Urban1	100		
Urban2	0		
Feedlots	0		
Streets	10		
Other2	0		
Other3	0		

Phosphorus Loading	(No street treatment)	kg/yr
Agriculture		24024
Forest		433
Urban		62
Feedlots		0
Precipitation		187
Septic Tanks		1125
Point Sources		0
Streets		11

Estimated Total = 25842 (kg/yr)

Nitrogen Loading	(No street treatment)	kg/yr
Agriculture		617760
Forest		10262
Urban		516
Feedlots		0
Precipitation		374
Septic Tanks		9974.
Point Sources		0
Streets		54

Estimated Total = 638943 (kg/yr)

Predicted Responses

Variable (units)	5th %ile	Expected	95th %ile
Total P-in (mg/l)		0.40	
Total N-in (mg/l)		9.98	
Total P (mg/l)	0.06	0.08	0.11
Total N (mg/l)	0.67	0.70	0.73
Chlor a (ug/l)	10.1	12.9	16.3
Secchi Depth (m)		2.2	
Prob Hypo Anoxia	0.0000		0.0000
Prob BG Dominant	0.0000		0.0000
THMs	0.0000	0.0000	0.0000
TSI	58.1	61.5	64.8

Appendix B. Project website: www.telwf.org/stormdrain.htm

Storm Drains Project

Home | Up One Level | Contact Us | Table of Contents | About Us

Up One Level
Upcoming Events
Meeting Minutes
Donors
Leadership
Strategic Plan
Watershed Facts
Water Testing
Pictures
Links
Help Wanted

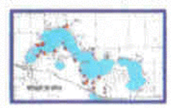
Lake Tippecanoe Storm Drain Project

This project, started in the summer of 2004, is funded by a grant from the Lake and River Enhancement program of the Indiana Department of Natural Resources.. The goal of the project is twofold: first, to map all public storm drains surrounding Lake Tippecanoe and Little Tippecanoe, second to develop a plan to improve the quality of storm water draining into the lakes.

Storm water runoff often contains pollutant concentrations such as phosphorus, nitrogen, sediment, oil, and bacteria more than ten times higher than the natural lake water. This sudden input of pollutants during storms can adversely affect the quality of the lakes, causing algae blooms and reducing fish reproduction. Once this project is complete, the water quality in the lakes should be improved. Anticipated completion date is the end of December 2004.

The map below shows the locations of storm drain inlets observed to date. If you know of additional sites where storm water runoff flows directly into the lake through a pipe, contact Mike Lattimer at (574) 453-4716. Mike has volunteered to be the local contact for this part of the project.

Street Drains



<<< Click on Thumbnail Pictures to enlarge

Pipes to Lakes

Appendix C. Project brochure

WHAT HAPPENS NOW?

Several local property owners have agreed to make part of their land available for bioren-tion filters and vegetated filter strips. Installation of these best management practices will require some additional funding (approximately $40,000) and annual mainte-nance costs of about $1000.

Individual property owners should be encouraged to build their own rain gardens in low spots around their properties.

The Kosciusko County High-way Department has agreed to allow the use of catch basin inserts on county-maintained roads. The annual cost to install and maintain these in-serts is approximately $4000 if volunteer labor is used.

Funding for these projects could come from the Lake Tip-pecanoe Property Owners As-sociation, from private donors or from government grants.

Indiana Department of Natural Resources
Division of Soil Conservation
402 W. Washington Street, Room W265
Indianapolis, IN 46204

Tippecanoe Environmental Lake
and Watershed Foundation

P.O. Box 55
North Webster, IN 46555

Commonwealth Biomonitoring
8061 Windham Lake Drive
Indianapolis, IN 46214

"For Water Quality Improvement"

Tippecanoe Lake: Storm Drain Project

Sponsored by:

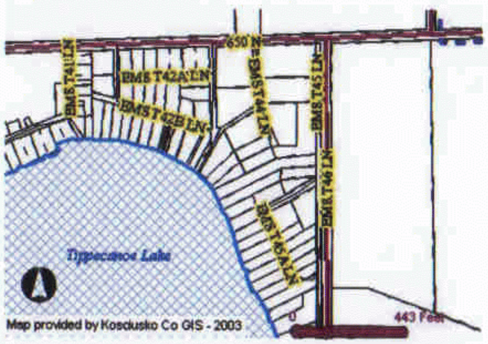
Tippecanoe Environmental
Lake & Watershed
Foundation

Tippecanoe Lake Storm Drain Project

A typical storm drain in Tippecanoe Lake

When it rains, storm water runoff has to go somewhere. If it falls on a hard surface like a road or parking lot, the runoff flows right into the nearest waterbody. Along the way it picks up pollutants and deposits them in our lakes.

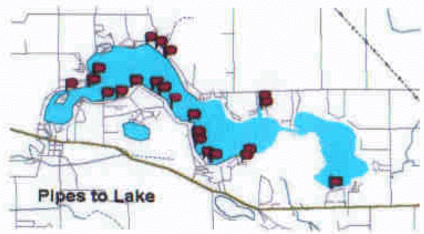
What kinds of pollutants enter the lake in storm water? Nutrients like phosphorus and nitrogen that contribute to algae blooms. Bacteria that make the water unsafe to swim in. Oil from cars. Pesticides from lawns. Cleaning up storm water runoff around the lake needs to be a high priority!



There are at least 10 miles of paved streets around Tippecanoe Lake. Most of the storm water goes untreated directly into the lake.

What did we learn?

There are at least 26 pipes that carry storm water to the lake. Associated with these pipes are at least 33 catch basins directing storm water off nearby streets and parking lots.



Pollutants find their way to the lake in storm water runoff.

Street runoff adds about 25 pounds of phosphorus and 150 pounds of nitrogen to the lake each year. This amount, though small compared to loading from the rest of the watershed, is one of the most easily eliminated sources of nutrients.

What are some solutions?

There are several "best management practices" that will help reduce pollution in storm water runoff. One of the easiest to implement is the use of catch basin filters in street grates.

Another possibility is the installation of bioretention filters ("rain gardens") where storm water accumulates along

roads. These are relatively inexpensive and add to a beautiful landscape.

Other solutions include installation of grass swales, detention ponds, and sand or wetland filters.

Appendix D. Public Meeting Details

Meeting One

Location:	Tippecanoe Country Club
Date:	May 2004
Attendance:	Lake Tippecanoe Property Owner’s Association
Purpose:	To inform the association about the goals of the project
Public comments:	Offers were made by local residents to point out storm drains on their property.

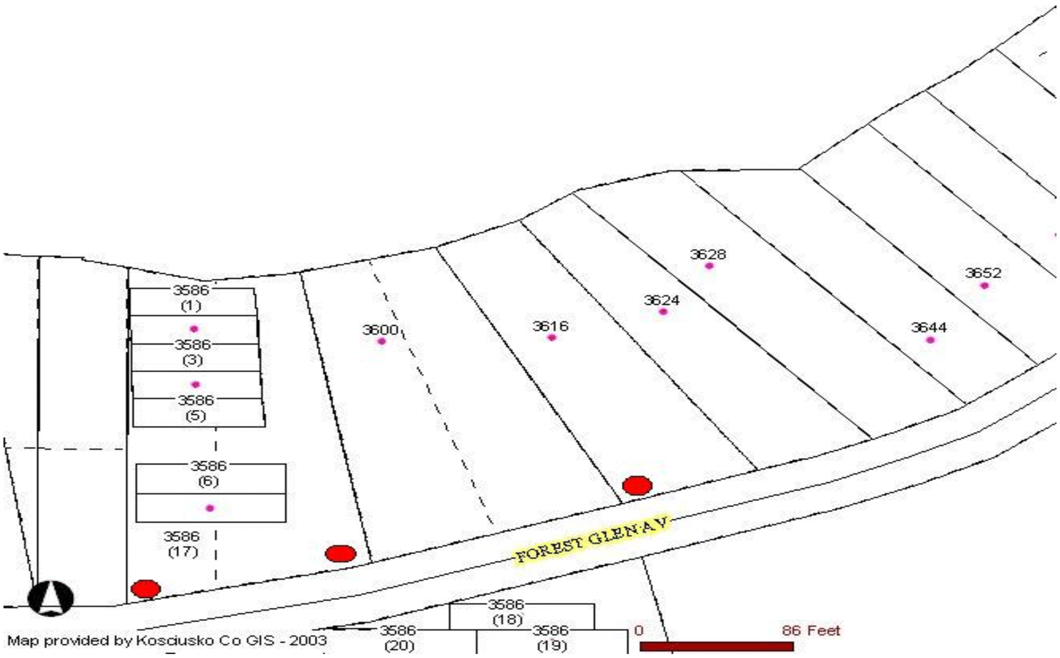
Meeting Two

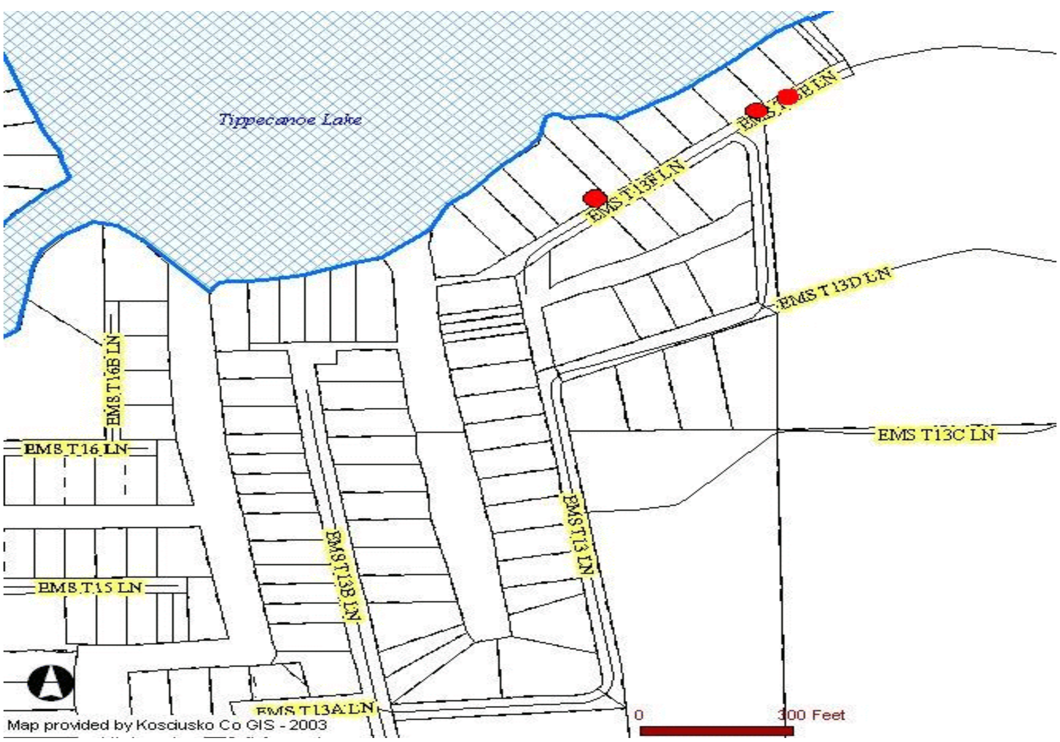
Location:	Tippecanoe Country Club
Date	August 2004
Attendance:	Lake Tippecanoe Property Owner’s Association
Purpose:	To show the initial results of storm drain mapping
Public comments:	Request from the LTPOA to put maps of storm drains on the TELWF website.

Meeting Three

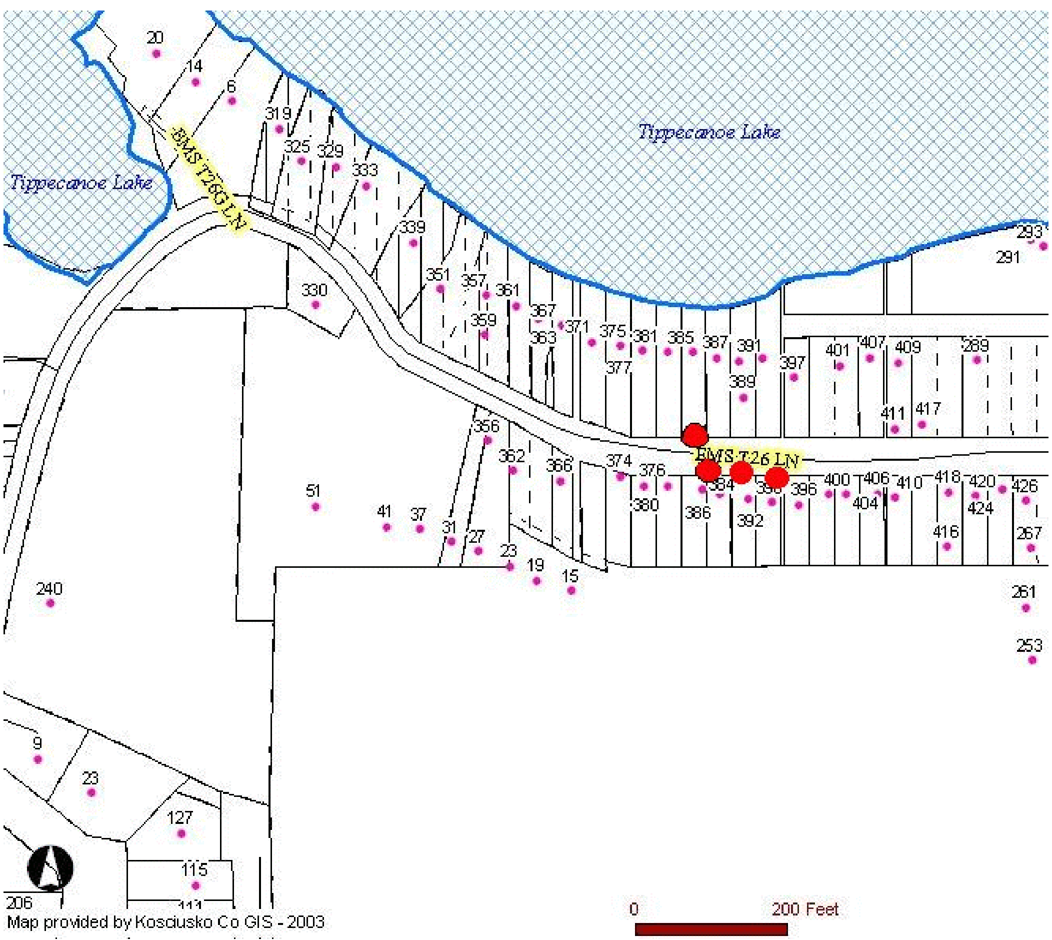
Location:	Oswego Lions Club
Date:	January 15, 2005
Attendance:	Lake Tippecanoe Property Owner’s Association
Purpose:	To present the results of the study and provide a forum to discuss what to do next.
Public comments:	Discussion of how the LTPOA and TELWF organizations should proceed with carrying out the recommendations presented in the report. Many of those present expressed surprise at how easily these recommendations could be carried out. The TELWF executive director will prepare grant requests as recommended in the report.

Appendix E. Drawings of storm grate locations on streets

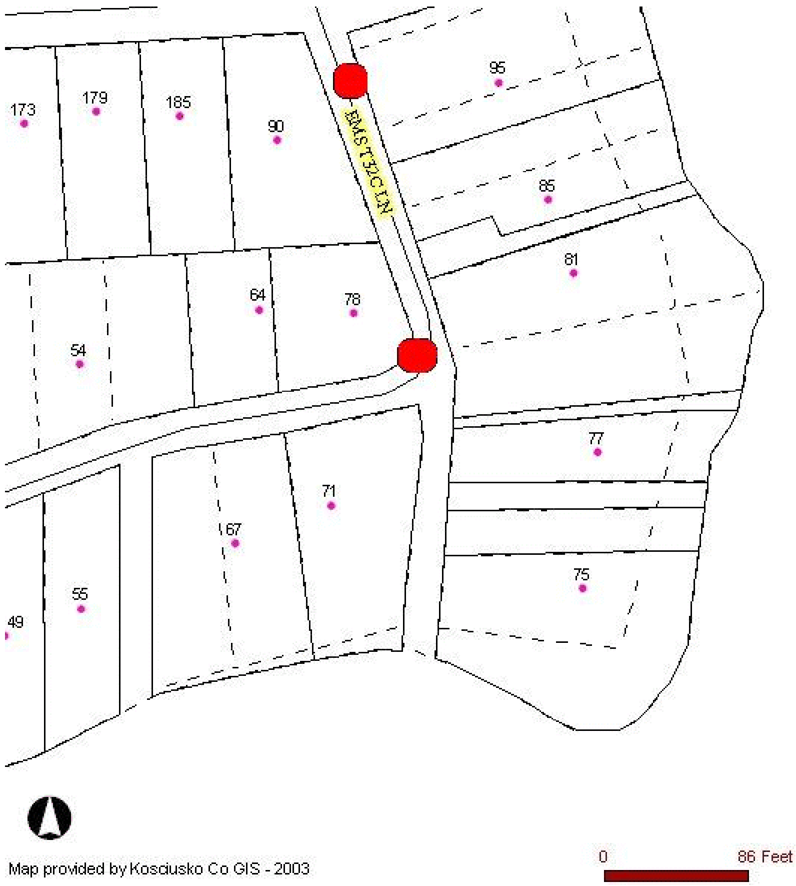




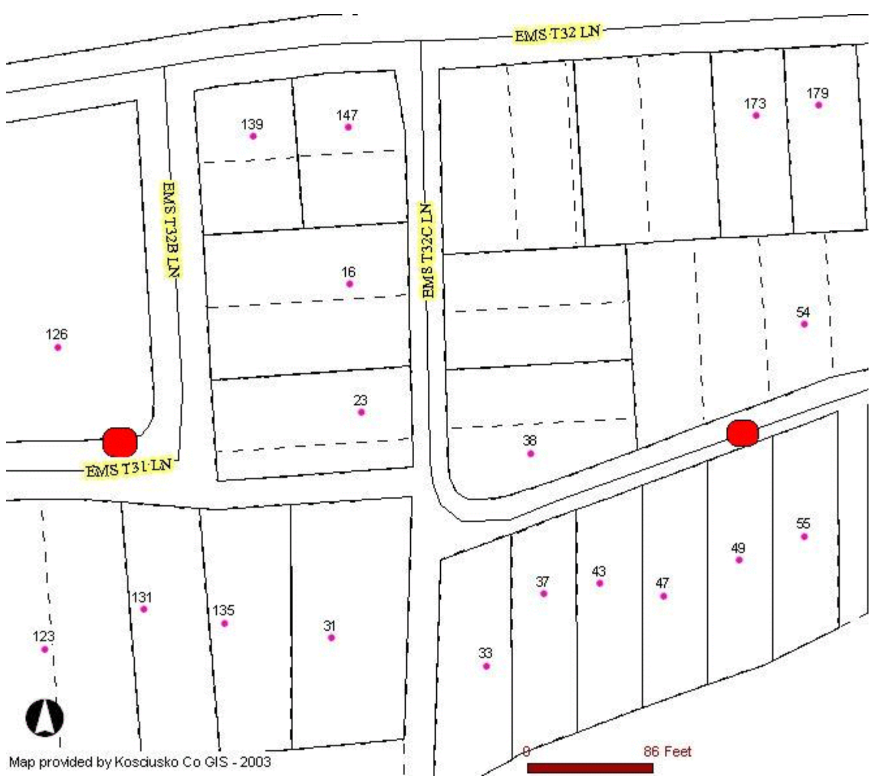
Tippecanoe Lake
EMS T17 LN
EMS T17A LN
EMS T16 LN
EMS T16A LN
EMS T15 LN
Map provided by Kosciusko Co GIS - 2003
0
124 Feet



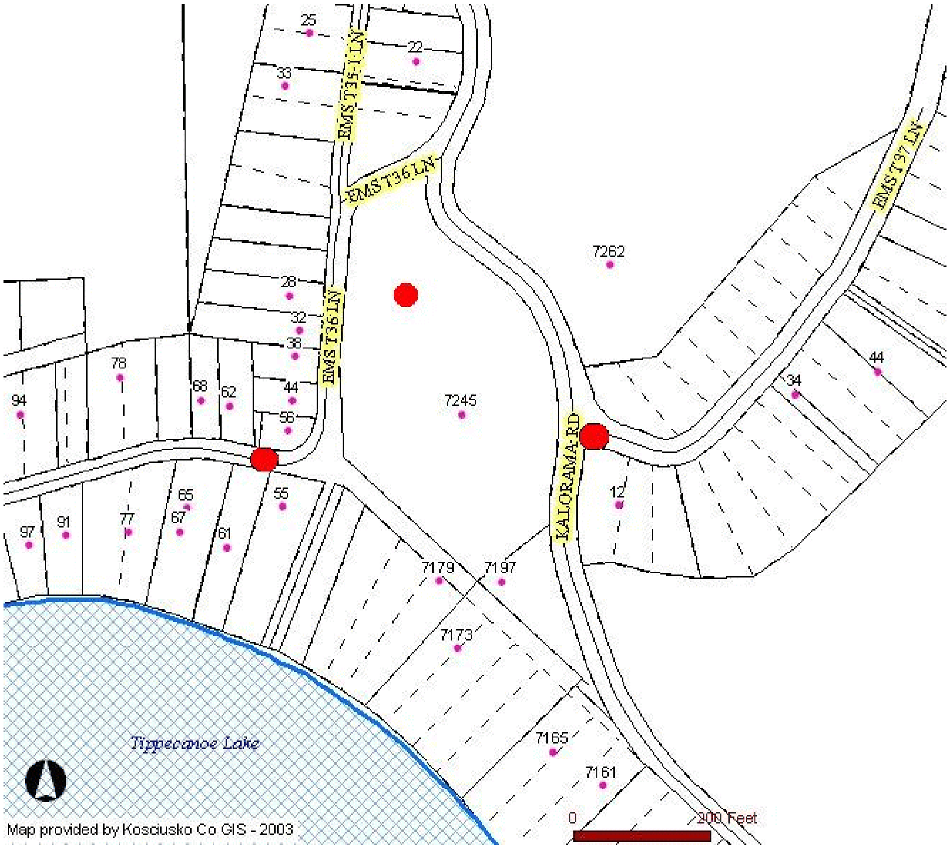
Tippecanoe Lake
Tippecanoe Lake
EMS T26G LN
EMS T26 LN
Map provided by Kosciusko Co GIS - 2003
0
200 Feet



EMS T32C LN
95
173
179
185
90
85
81
64
78
54
77
71
67
75
55
49
Map provided by Kosciusko Co GIS - 2003
0
86 Feet



EMS T32 LN
139
147
173
179
EMS T32B LN
EMS T32C LN
16
54
126
23
38
EMS T31 LN
55
49
37
43
47
131
135
31
123
33
Map provided by Kosciusko Co GIS - 2003
0
86 Feet


25
22
33
EMS T35-1 LN
EMS T36 LN
7262
EMS T37 LN
28
32
38
EMS T36 LN
44
78
68
62
44
56
34
94
7245
KALORAMA RD
12
65
55
97
91
77
67
61
7179
7197
7173
Tippecanoe Lake
7165
7161
Map provided by Kosciusko Co GIS - 2003
0
200 Feet


130
84
40
42
133
136
EMS T47 LN
EMS T48A LN
96
145
147
75
135
102
EMS T48 LN
85
106
155
EMS T48B LN
163
148
95
122
99
175
Tippecanoe Lake
Map provided by Kosciusko Co GIS - 2003
0
100 Feet